

Supplementary Information

Synthesis and physicochemical analysis of bimetalphthalocyanine pigment based on bivalent metals

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Table-1. Effect of mass ratio of $\text{Mg}(\text{CH}_3\text{COO})_2$ and $\text{Zn}(\text{CH}_3\text{CO}_2)_2 \cdot 2\text{H}_2\text{O}$ and temperature on pigment yield obtained for magnesium-zinc phthalocyanine

№	$\text{Mg}(\text{CH}_3\text{COO})_2:\text{Zn}(\text{CH}_3\text{CO}_2)_2 \cdot 2\text{H}_2\text{O}$	T, °C	ω, %	№	$\text{Mg}(\text{CH}_3\text{COO})_2:\text{Zn}(\text{CH}_3\text{CO}_2)_2 \cdot 2\text{H}_2\text{O}$	T, °C	ω, %
1		200	65,4	10		200	69,3
2	1,1:1	225	85,2	11	1:2,6	225	87,9
3		250	73,1	12		250	78,1
4		200	66,3	13		200	79,6
5	1:1,2	225	86,7	14	1:4,3	225	89,5
6		250	75,2	15		250	79,3
7		200	67,1	16		200	73,3
8	1:1,8	225	87,4	17	1:5	225	89,5
9		250	76,3	18		250	78,4

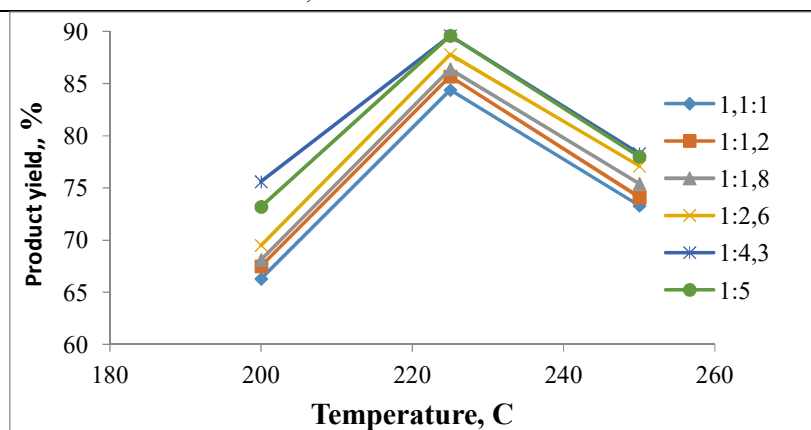


Figure 3. Graphic representation of the influence of the mass ratio of $\text{Mg}(\text{CH}_3\text{COO})_2$ and $\text{Zn}(\text{CH}_3\text{CO}_2)_2 \cdot 2\text{H}_2\text{O}$ and temperature on the yield of pigments obtained for magnesium-zinc phthalocyanine.

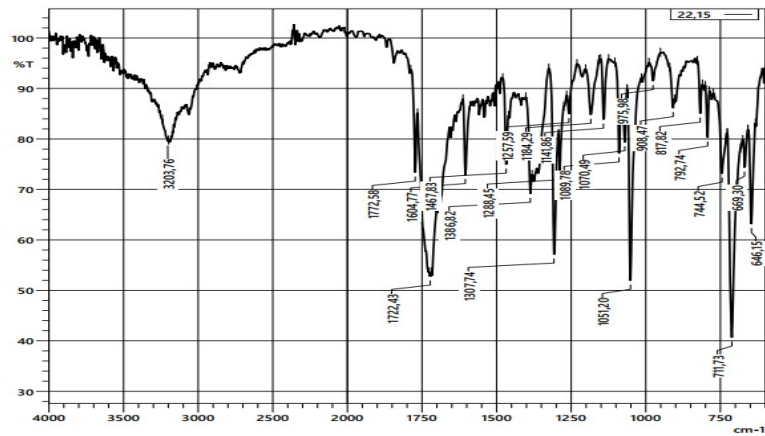


Figure 4. IR spectrum of magnesium-zinc-retaining phthalocyanine pigment

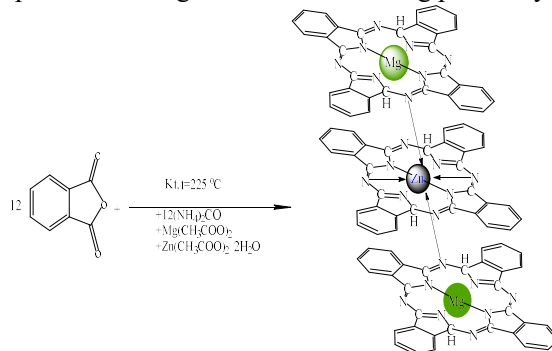


Figure 5. Magnesium-zinc preservative phthalocyanine pigment extraction reaction.

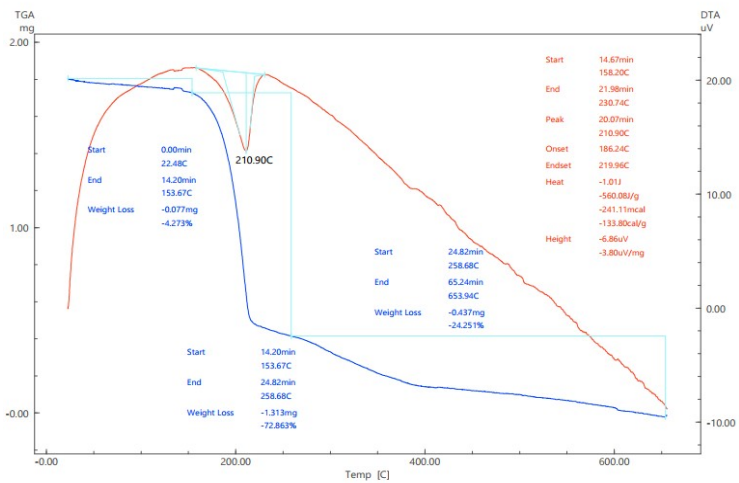


Figure 6. Thermogravimetric (TGA) and Differential Thermal Analysis (DTA) of Magnesium-Zinc Retaining Phthalocyanine Pigment.

Table-2. Effect of temperature on the weight loss of a magnesium-zinc-retaining phthalocyanine pigment sample

No	dw	1.80	1/T	dw/dt	Mg	minut	T ⁰ +K
1	1.76	0.0026	0.005	0.04	7.96	373	
2	1.40	0.0021	0.022	0.4	17.95	473	
3	0.35	0.0017	0.051	1.45	27.96	573	
4	0.14	0.0014	0.043	1.66	37.96	673	
5	0.10	0.0012	0.035	1.7	47.95	773	
6	0.03	0.0011	0.030	1.77	57.95	873	
7	0.007	0.0010	0.019	1.79	63.21	926	

Table 3. Results of thermal-oxidation analysis of magnesium-zinc-retaining phthalocyanine pigment sample.

No	dw	1.80	Ln(W ₁ /W ₂)	1/T *10 ⁻³
1	1.76	0.022	2.6	
2	1.40	0.251	2.1	
3	0.35	1.637	1.7	
4	0.14	2.554	1.4	
5	0.10	2.891	1.2	
6	0.03	4.098	1.1	
7	0.007	5.572	1.0	

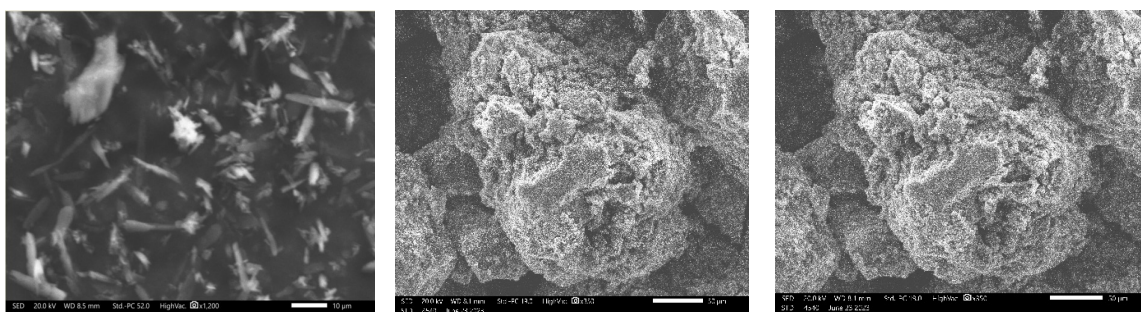


Figure 7. Electron microscope image of magnesium zinc phthalocyanine pigment (Mg-ZnPc) surface magnified 1200 times.

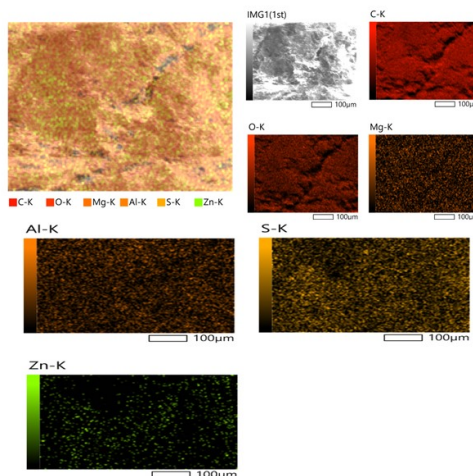
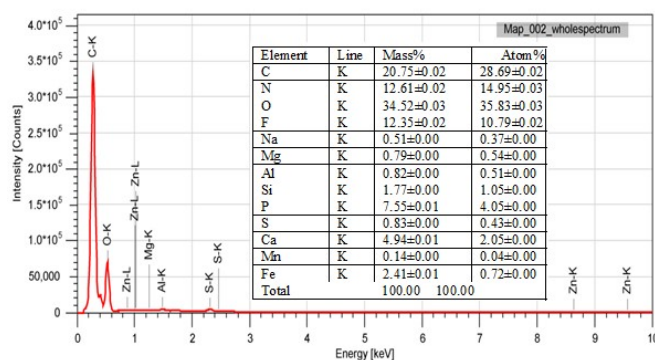


Figure 8. (a) EDS element map and (b) EDS results of magnesium zinc phthalocyanine pigment (Mg-ZnPc).

Table-4. Comparison of synthesized magnesium-zinc-retaining phthalocyanine pigment according to GOST 6220-76.

№	The name of the indicators	Indicator standard		Mg - ZnPc
		High grade	The first variety	
1	Coloring power (concentration),%	100	100	100
2	Purity of colors	Suitable		Suitable
3	The mass percentage of water and volatile substances, %, is not much	0,4	1,5	0,3
4	The mass fraction of the residue after wet sieving, %, is not much	0,1	0,8	0,1
5	The mass fraction of the residue after dry sieving, %, is not much	0	0,5	0
6	The mass percentage of water-soluble substances, %, is not much	0,1	1,0	0,1
7	Water extract reaction (pN)	5,5-7,0	5,5-7,0	6,7
8	Fluidity of printing inks, mm	Suitable		Suitable
9	Dispersion, mm: for polyvinyl chloride printing inks	Suitable		Suitable
10	Migration resistance: in polyvinyl chloride in rubber in a nitrocellulose coating	Do not migrate		Do not migrate
11	Reagents, binders, plasticizers, light and weather resistance	Fits standard pattern		Suitable